

Hydrogen Blending at UCSD Plan Workpaper Supporting Chapter 3

Joint Amended IOU Hydrogen Blending Demonstration Application
(A.22-09-006)

Explanation of Work Paper

This work paper (WP-3) includes all Class 5 cost estimates to support the SDG&E Hydrogen Blending Demonstration Project (Project) at the University of California, San Diego (UCSD). For information on Loaded Costs and revenue requirements, see Chapter 7 testimony.

Table 1 summarizes the O&M costs related to the project. Tables 2 to 5 reflect the costs by Project Phase, as laid out in Chapter 3 of the testimony. Detailed cost estimates and assumptions to support the work paper are provided in WP-3 Appendix A and WP-3 Appendix B.

Table 1: Project Cost Estimates, (\$M)

Table 1: Total Capital and O&M						
	(\$M)					
	2025	2026	2027	2028	2029	Total
Capital	0.0	0.0	0.0	0.0	0.0	0.0
O&M	7.2	6.4	0.6	1.8	0.1	16.1
Total	7.2	6.4	0.6	1.8	0.1	16.1

Cost Mechanism Justification

The Project at UCSD is designed to be a temporary research project. Once the Project is planned, designed, constructed, and commissioned, SDG&E will test various hydrogen blends on UCSD's property over the course of approximately 18 months. For information on Summary of Project Phases and Schedule, see Chapter 3 testimony. The short-term nature of the project planned at UCSD makes it unusual compared to most utility activities and closer to a research and development (R&D) program than a typical capital project. For this reason, all of the equipment costs and related direct labor are being treated as O&M.

Project Description

The SDG&E Project is unique and differentiated in that it seeks to understand the impacts of hydrogen blending in state-of-the-art PE pipes. The Project will blend hydrogen into a purpose-built medium-pressure natural gas distribution pipeline loop isolated from the central natural gas system.

The site used for preliminary design is in a parking lot southeast of Genesee Avenue and Campus Point Drive in San Diego, CA, commonly known as the "Voight Parking Lot." This location is subject to change and is dependent on UCSD's preference. The Project will begin by observing 100% natural gas in the new pipeline system. Once that baseline is established, SDG&E plans to blend and inject electrolytic hydrogen produced onsite into the system, starting at 5% H2 by volume and up to 20% by volume over time. The

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blend volume will be gradually increased, and performance of the system validated with testing throughout the project, including evaluating key impacts on pipes, valves, meters, and end-use equipment. Upon conclusion of the estimated 18-month testing period, all hydrogen-related equipment deployed for the testing program will be removed from the site, and the site shall be restored.

Project Plan

Table 2. Summary of Project Phases

PHASE & ACTIVITY	DESCRIPTION	ESTIMATED DURATION
0. Pre-development	All efforts supporting this application submittal are considered “Pre-development.” Upon Commission approval, the Project will move on to subsequent phases.	Pre-application submittal
1. Planning, Design, Construction and Commissioning	Hydrogen production and blending equipment are procured; the system is designed, constructed, permitted, and commissioned on UCSD property; PE pipes and meters are installed; inspections and any necessary remediation are conducted; stakeholder engagement commences.	24 months
2. Testing and Demonstration	Hydrogen is blended into the system on a testing schedule; data is collected; equipment and pipelines are periodically inspected; and samples of pipelines and components are collected.	24 months (18 months live blending, + 6 months asset inspection & validation)
3. Decommissioning & Equipment Removal, and System Restoration	Hydrogen equipment is removed from UCSD property, and the site is restored.	Five months
4. Knowledge Sharing	Data from the pilot is interpreted and disseminated; a public report will be released.	Nine months

Forecast Methodology (Construction Costs and Labor)

SDG&E’s methodology for forecasting costs is discussed in the Direct Testimony of Pooyan Kabir (Chapter 3). SDG&E used a Level 5 Estimate for Total Installed Cost (TIC) estimate to implement the scope of work in Phases 1 & 3. The TIC Estimate includes direct costs associated with project management, engineering and design, environmental permitting, material and equipment procurement, and construction. For programmatic and RD&D-related expenses in Phases 2 & 4, the forecast method

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developed for this cost category is zero-based. This method is most appropriate because RD&D needs and activities will evolve with the project, and this is a new type of project with new technologies.

During cost estimate preparation, this project was in the preliminary site layout design level and scope. Further development of this project could reveal new information requiring some adjustments to the project plan in areas such as engineering, materials, permitting, environmental and land, staffing, and customer engagement, all of which could impact actual costs compared to this cost estimate. An average 30% contingency has been placed on all fees.

Schedule

The Project implementation is proposed to be completed consistent with the overall prioritization and timing described in Chapter 3 testimony. The critical project deliverables were identified and incorporated into a work breakdown structure. This work breakdown structure was sequenced, and predecessor and successor tasks were linked to each task. Durations were added to each task to provide a total project duration.

PHASE 1 COSTS

Phase 1	2025	2026	2027	2028	2029	Total
Capital	0.0	0.0	0.0	0.0	0.0	0.0
O&M	7.2	6.3	0.0	0.0	0.0	13.5
Total	7.2	6.3	0.0	0.0	0.0	13.5

Phase 1 Assumptions

Refer to WP-3 Appendix A for a detailed list of assumptions used to develop Phase 1 estimates.

PHASE 2 COSTS

Phase 2	2025	2026	2027	2028	2029	Total
Capital	0.0	0.0	0.0	0.0	0.0	0.0
O&M	0.0	0.1	0.6	0.3	0.0	1.0
Total	0.0	0.1	0.6	0.3	0.0	1.0

Phase 2 Assumptions

The following assumptions were made to develop this cost estimate:

- Class 5 Estimate (- 50% / +100%);

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- Monthly odorant sampling and analysis;
- Monthly leak surveys and leak detection equipment evaluation;
- Monthly equipment checks;
- Quarterly maintenance of major equipment (blending skid and electrolyzer);
- Cost of electricity and water for the duration of the project;
- Alarm testing;
- Pre-hydrogen blend exposure and post-hydrogen blend exposure pipeline sampling and analysis;
- Program management; and
- 25% contingency in alignment with Class 5 estimates is included.

Refer to WP-3 Appendix B for a detailed list of assumptions to develop Phase 2 estimates.

PHASE 3 COSTS

Phase 3	2025	2026	2027	2028	2029	Total
Capital	0.0	0.0	0.0	0.0	0.0	0.0
O&M	0.0	0.0	0.0	1.3	0.0	1.3
Total	0.0	0.0	0.0	1.3	0.0	1.3

Phase 3 Assumptions

Refer to WP-3 Appendix A for a detailed list of assumptions to develop Phase 3 estimates.

PHASE 4 COSTS

Phase 4	2025	2026	2027	2028	2029	Total
Capital	0.0	0.0	0.0	0.0	0.0	0.0
O&M	0.0	0.0	0.0	0.2	0.1	0.3
Total	0.0	0.0	0.0	0.2	0.1	0.3

Phase 4 Assumptions

The following assumptions were made to develop this cost estimate:

- Class 5 Estimate (- 50% / +100%);

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- An engineering and data team of 6, each employee working 15 hours per week for 27 weeks;
- A management team of 2, each employee working 10 hours per week for 27 weeks; and
- 25% contingency in alignment with Class 5 estimates is included.

Refer to WP-3 Appendix B for a detailed list of assumptions to develop Phase 4 estimates.

**SDGE-UCSD H2 Blending Estimate Phase 1
PROJECT SUMMARY**

Summary Description	Bare Total	Contingency	Total Cost	Basis
Contractor Mechanical Work	\$ 2,688,204	30%	\$ 806,461 \$ 3,494,664	
Contractor Electrical Work	\$ 520,832	30%	\$ 156,250 \$ 677,082	PM instruction (60% of Contractor Costs)
Material- Pipe	\$ 4,413	30%	\$ 1,324 \$ 5,737	PM instruction (60% of Contractor Costs)
Material-Valves & Fittings	\$ 126,702	30%	\$ 38,011 \$ 164,713	See "Digs - Capital" Tab
Material- Other	\$ 3,361,840	30%	\$ 1,008,552 \$ 4,370,392	See "Elect - Capital" Tab
Sub-Total Construction and Materials	\$ 6,701,991		\$ 2,010,597 \$ 8,712,587	

Summary Description	Bare Total	Override	Contingency	Total Cost	Basis
Bellhole Inspection Services	\$ 36,301	0.5%	30%	\$ 10,890 \$ 47,192	See "Digs - Capital" Tab
SCG / SDG&E Labor - Union T/H	\$ 192,000	0.1%	30%	\$ 57,600 \$ 249,600	2 workers for project duration
SCG / SDG&E Labor - Outreach & Public Affairs	\$ 100,000	3.5%	30%	\$ 30,000 \$ 130,000	PM request
SCG/SDG&E Labor – Engineering Design	\$ 200,000	0.8%	30%	\$ 60,000 \$ 260,000	Spec quote received
SCG/SDG&E Labor –PM	\$ 200,000	-	30%	\$ 60,000 \$ 260,000	PM instruction
SCG/SDG&E – Mechanical and Electrical Work	\$ 1,807,021	-	30%	\$ 542,106 \$ 2,349,127	PM instruction (40% of Contractor Costs)
Engineering/Designs Services	\$ 175,000	-	30%	\$ 52,500 \$ 227,500	PM instruction
PM / Project Services	\$ 88,750	-	30%	\$ 26,625 \$ 115,375	PM instruction
Construction Management / Inspection	\$ 327,000	2.1%	30%	\$ 98,100 \$ 425,100	Based on project duration
Surveying / As-builts	\$ 35,000	0.2%	30%	\$ 10,500 \$ 45,500	Historical %
Environmental Services	\$ 100,000	3.0%	30%	\$ 30,000 \$ 130,000	PM request
Pressure Test Certification Services	\$ -	0.1%	30%	\$ - \$ -	Not needed per PM request
Water Storage	\$ 17,021	0.3%	30%	\$ 5,106 \$ 22,127	Historical %
Weld X-Ray / NDE	\$ 26,656	0.1%	30%	\$ 7,997 \$ 34,653	Days of welding at \$2200/dy
Land Services	\$ 42,553	0.6%	30%	\$ 12,766 \$ 55,318	Laydown area for staging materials
CNG / LNG	\$ -	1.2%	30%	\$ - \$ -	Assumes not needed
Gas Capture / Cross Compression	\$ -	0.8%	30%	\$ - \$ -	Assumes not needed
Miscellaneous Services	\$ 212,763	3.2%	30%	\$ 63,829 \$ 276,592	Historical %
Outreach & Public Affairs (Third Party)	\$ 60,000	0.2%	30%	\$ 18,000 \$ 78,000	PM request
Permits	\$ 34,042	0.5%	30%	\$ 10,213 \$ 44,255	Historical %
Other Non-Labor Costs	\$ 14,600		30%	\$ 4,380 \$ 18,980	5% of SCG / SDG&E labor
Total Direct Estimated Cost (No Loaders)	\$ 10,370,697		\$ 3,111,209 \$ 13,481,906		

Basis Of Estimate
Project Details:
Project Location: South side of Genesee Ave, intersection of Genesee Ave and Campus Point Dr (32°52'53.5293", -117°13'12.4415")
High Level Schedule: N/A
Peak Load: None provided
Pipeline Extension Diameter: 2" - 1"
Pipeline Extension Length: 1080 LF
Gas Source: Natural Gas
Collectable:
Scope Of Work:
Design and build a hydrogen blending site that will produce hydrogen onsite. A compound will be built in an existing parking lot that will utilize a PEM electrolyzer as the key component to producing hydrogen. Natural gas, water, sewer and electrical utilities will be extended from nearby sources to site compound equipment.
Assumptions:
<p>The following assumptions and clarifications were used in the creation of this estimate based on feedback from the project team:</p> <ul style="list-style-type: none"> - Estimating Benchmarking database was utilized to source comparable projects. - Additional costs for closeout/commissioning to be assumed based on past projects - Assumes 5x10s work schedule - Assumes site will be closed to the public during construction - Assumes equipment and materials will be staged in the same parking lot as the compound - Rates are based on average union rates - Includes installation of 330 LF of 2" and 200 LF of 1" PE pipe and associated appurtenances - Assumes primary electrical connection is within 300 LF of compound - Assumes equipment foundations will be scarified and compacted prior to pouring concrete - Assumes water connection is within 200 LF of compound - Assumes sewer connection is within 200 LF of compound - Includes (1) flow meter and (2) gas analyzers - Includes hydrogen detectors, fire detectors, and ESD system - Assumes existing asphalt is up to 6" thick and no existing substructures - Includes (50) bollards at compound and surrounding equipment - Project includes new SCADA enclosure that lies outside of Class 1, Div 1 area with a raised foundation pad - Assumes third party will be hired to design and build the blending skid, including its control systems - Assumes pipe is 2" & 1" PE pipe with the same specifications as natural gas requirements - Assumes site is currently asphalt and will be excavated using mechanical means - Includes (10) days of contractor commissioning support for equipment - Assumes mechanical and electrical work will be performed at the same time - Assumes joint trenching can be utilized for pipe and conduits - Includes 0 sac slurry for backfilling trenches - <i>Includes 30% contingency - per PM request</i>
Exclusions and Basis Of Estimate:
<ul style="list-style-type: none"> - Excludes seismic design considerations - Excluding actuals spent to date - Excludes Force Mejeur - Excludes site drainage modifications - Landscaping - Estimate excludes any maintenance and utility costs that would be incurred after site is operational - Ongoing electrical costs once site is operational - Masonry walls - Traffic control, assumes parking lot will be closed during construction - Removal of trees or existing underground structures within site - Geotechnical studies - Overexcavation for equipment pads due to soil stability issues - More than 1 mobilization - Off-site work - Site security - Removal or relocation of unrelated owner equipment obstructing construction - Permanent site fencing - Site paving - Demo/removal of any existing substructures - Land leasing costs or Land Acquisition - Equipment enclosures or sound mitigation methods - Site lighting - Handling, hauling, excavating contaminated soils - Site grading - Watertable controls/ Site dewatering - Decommissioning/removal of site equipment - Haz ops site assessment - Demo/removal of any existing substructures - Delays caused by road moratoriums

Project Info			
Project Name	SDGE-UCSD H2 Blending Estimate Phase 1		Estimate Rev.
Project Manager	Jeamy Sic		I/O
Prepared Date	45246		WOA
Prepared By	Ryan Heather		Line Number

WOA Summary

Type	O&M Project			TOTALS
Company Labor	\$ 3,248,727			\$ 3,248,727
Contract Labor	\$ 4,071,211			\$ 4,071,211
Pipe Costs	\$ 5,737			\$ 5,737
Other Stores Material	\$ 164,713			\$ 164,713
Purchased Material	\$ 4,370,392			\$ 4,370,392
Purchased Services	\$ 1,457,357			\$ 1,457,357
Paving	\$ 100,534			\$ 100,534
Permits	\$ 44,255			\$ 44,255
Other Direct Costs	\$ 18,980			\$ 18,980
TOTAL DIRECT COSTS	\$ 13,481,906			\$ 13,481,906

Constr & Mat	N/A			
% Split	N/A			

**SDGE-UCSD H2 Blending Estimate Phase 3
PROJECT SUMMARY**

Summary Description	Bare Total		Contingency	Total Cost	Basis
Mechanical Contractor	\$ 800,802		30%	\$ 240,240	\$ 1,041,042 See "Digs - Capital" Tab
Electrical Contractor	\$ 59,395		30%	\$ 17,818	\$ 77,213 See "Elect - Capital" Tab
Material- Pipe	\$ -		30%	\$ -	\$ - See "Digs - Capital" Tab
Material-Valves & Fittings	\$ -		30%	\$ -	\$ - See "Digs - Capital" Tab
Material- Other	\$ -		30%	\$ -	\$ - See "Elect - Capital" Tab
Sub-Total Construction and Materials	\$ 860,197			\$ 258,059	\$ 1,118,255

Summary Description	Bare Total	Override	Contingency	Total Cost	Basis
Bellhole Inspection Services	\$ 4,033	3.9%	30%	\$ 1,210	\$ 5,244 See "Digs - Capital" Tab
SCG / SDG&E Labor - Union T/H	\$ 65,600	0.1%	\$ 65,600	30%	\$ 19,680 \$ 85,280 2 workers for project duration
SCG / SDG&E Labor - Outreach & Public Affairs	\$ 12,903	1.5%	30%	\$ 3,871	\$ 16,774 Historical %
Engineering / Design Services	\$ 15,000	0.8%	\$ 15,000	30%	\$ 4,500 \$ 19,500 Minimal
PM / Project Services	\$ 84,150	3.5%	\$ 84,150	30%	\$ 25,245 \$ 109,395 Based on project duration and stage
Construction Management / Inspection	\$ 42,025	2.1%	\$ 42,025	30%	\$ 12,608 \$ 54,633 Based on project duration
Surveying / As-builts	\$ 20,000	0.2%	\$ 20,000	30%	\$ 6,000 \$ 26,000 Historical %
Environmental Services	\$ 21,505	2.5%	30%	\$ 6,451	\$ 27,956 Minimal
Pressure Test Certification Services	\$ -	0.1%	\$ -	30%	\$ - \$ - Pipe size & duration of sub onsite
Water Storage	\$ 1,720	0.2%	30%	\$ 516	\$ 2,237 Historical %
Weld X-Ray / NDE	\$ -	0.1%	\$ -	30%	\$ - \$ - Days of welding at \$2200/dy
Land Services	\$ -	0.0%	30%	\$ -	\$ - Assumes not needed
CNG / LNG	\$ -	1.2%	\$ -	30%	\$ - Assumes not needed
Gas Capture / Cross Compression	\$ -	0.8%	\$ -	30%	\$ - Assumes not needed
Miscellaneous Services	\$ 25,806	3.0%	30%	\$ 7,742	\$ 33,548 Historical %
Outreach & Public Affairs	\$ -		30%	\$ -	\$ - Assumes not needed
Permits	\$ 4,301	0.5%	30%	\$ 1,290	\$ 5,591 Historical %
Other Non-Labor Costs	\$ 3,925		\$ 3,925	30%	\$ 1,178 \$ 5,103 5% of SCG / SDG&E labor
Total Direct Estimated Cost (No Loaders)	\$ 1,161,165			\$ 348,350	\$ 1,507,570

Phase 3 - Basis of Estimate

Basis Of Estimate	
Project Details:	
Project Location: South side of Genesee Ave, intersection of Genesee Ave and Campus Point Dr (32°52'53.5293", -117°13'12.4415")	
High Level Schedule: N/A	
Peak Load: None provided	
Pipeline Extension Diameter: 2"	
Pipeline Extension Length: 1080 LF	
Gas Source: Natural Gas	
Collectable: No	
Scope Of Work:	
Phase 2 includes the decommissioning and removal of site equipment and foundations installed during phase 1 with the exception of the blending skid. The blending skid will be relocated to a more central location.	
Assumptions:	
<p>The following assumptions and clarifications were used in the creation of this estimate based on feedback from the project team:</p> <ul style="list-style-type: none"> - Estimating Benchmarking database was utilized to source comparable projects. - Assumes 5x10s work schedule - Includes demolition of: <ul style="list-style-type: none"> Concrete equipment foundations Compound Fencing Bollards - Includes disposal of debris according to city codes - Includes asphalt paving at compound location after equipment removal - Includes disconnecting power lines - Includes trucking/hauling equipment needed to lift and transport skids and equipment - Assumes underground PE gas piping installed in phase 1 will be abandoned in place - Includes 30% contingency - per PM request 	
Exclusions and Basis Of Estimate:	
<ul style="list-style-type: none"> - Excluding actuals spent to date - Excludes Force Mejeur - Excludes site drainage modifications - Permanent fencing - Landscaping - Handling/removing hazardous materials - More than 1 mobilization - Off-site work - Site security - Re-installation of removed equipment at future sites - Cost to dispose of electrical waste - Long Term Storage of Used Equipment - Excludes water & sewer work - Re-installing removed equipment and future sites 	

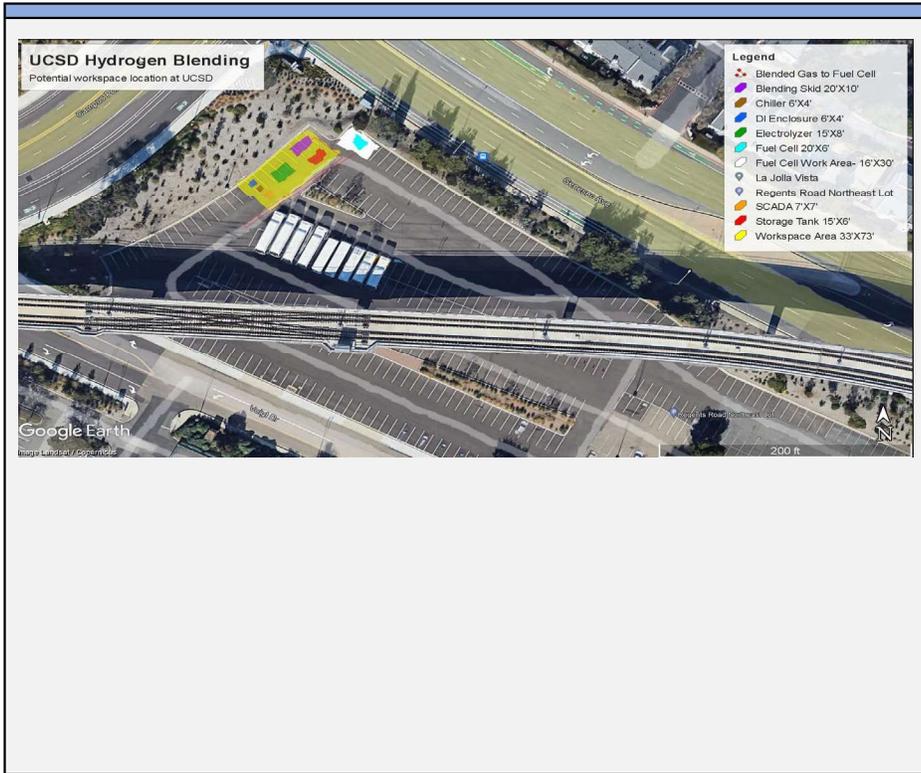
Project Info

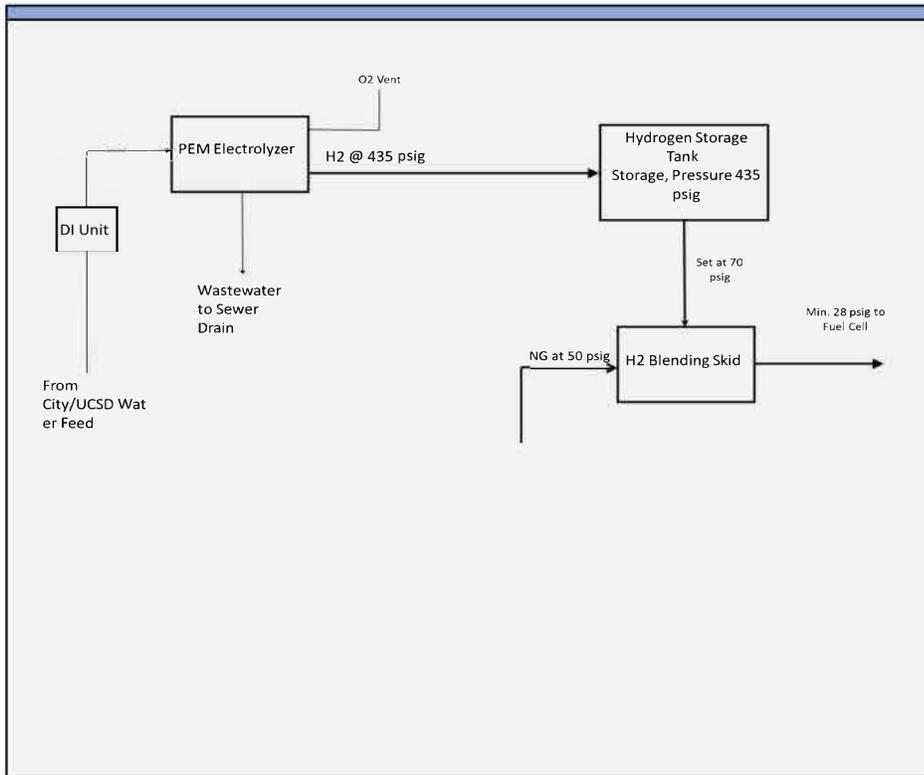
Project Name	SDGE-UCSD H2 Blending Estimate Phase 3	Estimate Rev.	7
Project Manager	Jeamy Sic	I/O	300828688
Prepared Date	11/16/2023	WOA	
Prepared By	Ryan Heather	Line Number	N/A

WOA Summary

Type	O&M Project	TOTALS
Company Labor	\$ 102,054	\$ 102,054
Contract Labor	\$ 1,002,654	\$ 1,002,654
Pipe Costs	\$ -	\$ -
Other Stores Material	\$ -	\$ -
Purchased Material	\$ -	\$ -
Purchased Services	\$ 278,512	\$ 278,512
Paving	\$ 113,656	\$ 113,656
Permits	\$ 5,591	\$ 5,591
Other Direct Costs	\$ 5,103	\$ 5,103
TOTAL DIRECT COSTS	\$ 1,507,570	\$ 1,507,570

Constr & Mat	N/A	
% Split	N/A	





Phase 2

Description	Months	# Staff	Hours per Staff	Rate (2023 rates)	Total	Total w/ 25% Cont.	Union	Management	3rd Party
Oderant Sampling and Analysis	18	1	13	\$ 53.38	\$ 12,490.92	\$ 15,613.65	\$ 15,613.65	\$ -	\$ -
Leak Surveys and Equipment	18	2	13	\$ 55.00	\$ 25,740.00	\$ 32,175.00	\$ 16,087.50	\$ 16,087.50	\$ -
Pipe Sampling (Excavation - Plastic)					\$ 100,000.00	\$ 125,000.00			\$ 125,000.00
Pipe Sample Prep & Analysis (Plastic)					\$ 11,528.00	\$ 14,410.00			\$ 14,410.00
Alarm Testing	18	2	6	\$ 55.00	\$ 11,880.00	\$ 14,850.00	\$ 14,850.00		
Blending Skid Operations, Distribution	18	2	6	\$ 50.00	\$ 10,800.00	\$ 13,500.00	\$ 13,500.00		
M&R Instrumentation Specialist	18	2	60	\$ 53.38	\$ 115,300.80	\$ 144,126.00	\$ 144,126.00		
Water (non-labor)	18				\$ 280.83	\$ 351.04			\$ 351.04
Electricity (non-labor)	18				\$ 102,237.31	\$ 127,796.63			\$ 127,796.63
Vehicle Utilization					\$ 37,586.12	\$ 46,982.65	\$ 46,982.65		
Services Agreement for Major Equipment					\$ 60,000.00	\$ 75,000.00			\$ 75,000.00
Program Management (50% FTE 4 years @125K)					\$ 312,500.00	\$ 390,625.00		\$ 390,625.00	
TOTAL PHASE 2					\$ 800,343.98	\$ 1,000,429.97	\$ 251,159.80	\$ 406,712.50	\$ 342,557.67

	2026	2027	2028	2029	TOTAL
Union	\$ -	\$ 107,639.91	\$ 143,519.89	\$ -	\$ 251,159.80
Management	\$ -	\$ 174,305.36	\$ 232,407.14	\$ -	\$ 406,712.50
3rd Party	\$ -	\$ 146,810.43	\$ 195,747.24	\$ -	\$ 342,557.67
TOTAL Phase 2	\$ -	\$ 428,755.70	\$ 571,674.27	\$ -	\$ 1,000,429.97

Phase 4

Description	Months	Staff	Hours per Staff	Rate (2023 rates)	Total	Total w/ 25% Cont.	Union	Management	3rd Party
Hydrogen Engineering and Data Team	27	6	15	\$ 69.35	\$ 168,522.84	\$ 210,653.55		\$ 210,653.55	
Management	27	2	10	\$ 78.37	\$ 42,317.31	\$ 52,896.63		\$ 52,896.63	
TOTAL PHASE 4					\$ 210,840.14	\$ 263,550.18	\$ -	\$ 263,550.18	\$ -

	2026	2027	2028	2029	TOTAL
Union	\$ -	\$ -	\$ -	\$ -	\$ -
Management	\$ -	\$ -	\$ 52,710.04	\$ 210,840.14	\$ 263,550.18
3rd Party	\$ -	\$ -	\$ -	\$ -	\$ -
TOTAL Phase 4	\$ -	\$ -	\$ 52,710.04	\$ 210,840.14	\$ 263,550.18